

ON THE PRESENT STATE OF KNOWLEDGE IN BACTERIAL SCIENCE
IN ITS SURGICAL RELATIONS.

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F. TUBERCULOSIS.

In the present stage of development of bacterial knowledge, when there still remain so many facts and conditions to be ascertained, so many important questions to be solved, before bacteriological doctrines can be admitted without reserve into our handbooks of clinical medicine, it affords a certain pleasure to contemplate the few chapters of bacterial science which treat of such forms of micro-organisms as have already by their never-failing presence in the tissues become a recognized clinical feature of certain diseases.

Thus anthrax and tuberculous are now diagnosed wherever their respective bacilli are found, and the diagnostic significance of their presence is admitted even by those who are inclined to skepticism in regard to the etiological rôle played by them.

The chain of experimental evidence, however, even as to the question of etiology is so complete, that it is only those who have not been occupied with the practical study of the subject that deny its convincing power. Tubercle-bacilli have been found wherever tuberculous disease was present, they have not been found in healthy or in otherwise affected tissues; they have been cultivated in pure cultures on suitable soils, and have produced tuberculous disease whenever inoculated into the animal body—by means of injection as well as of inhalation; and from these inoculations the original cultures have again been obtained. In some few recorded accidental cases the inoculation experiments have been proved to hold good of man as well.¹

¹Vide *E. A. Tscherning*, "Inoculations tuberculose beim Menschen," *Fortschritte der Med.* Vol. IV. P. 65, where a case is given of a healthy person who acquired tuberculosis through infection of a wound caused by breakage of a glass expectorating vessel, the contents of which closely resembled a pure culture of tubercle-bacilli.

See also *Kraske*, *abst.* this vol. P. 156.

The discovery of the tubercle-bacillus is attributed to R. Koch, of Berlin, who announced his discovery at a meeting of the Physiological Society, of Berlin, in April, 1882.¹ But it was not until nearly two years after this date that his celebrated paper on the subject² appeared in the second volume of the *Mittheilungen aus dem Kaiserlichen Gesundheitsamte*.³

This paper is most instructive and highly interesting to read. We learn from it that Koch had deliberately instituted a methodical search for parasites in tuberculous affections after weighing the circumstantial evidence of their presence adduced by the researches of Buhl, Ponfick and Weigert on miliary tuberculosis, and the pathological experiments of Klencke, Villemin, Klebs and Cohnheim and Salomonsen.

The paper, indeed, evidences astonishing diligence and application.

The first part, treating of the examinations made of pathological specimens, contains an account of how the author found the bacillus in forty-eight cases of pulmonary and miliary tuberculosis, and in sixty-four cases of surgical tuberculosis, the latter including twenty-one cases of scrofulous lymphatic glands, twenty-three cases of tuberculous bones and joints, four cases of lupus, and sixteen cases of tuberculous organs, including the uterus, bladder and testicles.

In like manner he examined specimens from a large number of animals. He furthermore produced artificial tuberculosis in over 500 animals, and examined them all thoroughly. Of the bacillus he produced forty-three pure cultures, some of which he continued through over thirty generations, occupying a period of two years. Infections with pure cultures, the foundation-stone upon which all bacteriological structures rest, he performed on 217 guinea-pigs, rabbits, cats and field-mice alone, besides a large number of other animals.

Koch's discovery was very soon corroborated by various authorities; in England by Watson Cheyne;⁴ in Germany by Ehrlich, P. Baumgar-

¹ *Lancet*. 1882. I. P. 625.

² "Die Aetiologie der Tuberculose." P. 1.

³ *Lancet*. 1884. I. 443.

⁴ Report on the Relation of micro-organisms to Tuberculosis. Presented to the Association for the Advancement of Medicine by Research. Feb. 1, 1883. *The Practitioner*, April, 1883. *Abst. Lancet*, 1883. I. 414.

ten and others, the latter demonstrating anatomically how after inoculation of the cornea the bacilli first multiply and subsequently become surrounded by epithelioid cells, in which manner tubercles are formed, corresponding to the number of bacilli.¹

On the other hand, however, there was no lack of writers who were in opposition to Koch and did not hesitate to attack his methods and conclusions. Spina², Schottelins, Dettweiler and Formad, of Philadelphia, were among his first opponents, against whose attacks Koch easily defended himself in his reply in the *Deutsche Medicinische Wochenschrift*.³ Formad, who believed that inoculation-tuberculosis could be produced by irritation alone, subsequently became satisfied of the specific nature of the disease—a literary history somewhat similar to that which attaches to the views of Williams⁴ and others in England—while Spina had simply designated Koch's observations as errors, and like the others, could not maintain his assertions.

Some authors, when Koch's views were first made known, attempted to attribute tuberculosis to species of micro-organisms other than Koch's bacilli, but were not successful. Among these were Toussaint⁵ and Klebs⁶; while Malassez and Vignal⁷, who described a disease resembling tuberculosis but differing in the micro-organisms found, appear to have observed a disease identical with the pseudo-tuberculosis of Eberth,⁸ a disease affecting rabbits and presenting a course similar to tuberculosis, but produced by a distinct species of bacilli.

All such communications were, however, far outweighed by the mass of literature which appeared in corroboration of Koch's statements.

The presence of the bacilli in phthisical sputum (as being the most

¹ Ueber den Nachweis der pathogenen Bedeutung der Tuberkelbacillen auf anatomisch-histologischen Wege." *Centralbl. f. d. medicin. Wiss.* 1883. No. 42.

² "Studien über Tuberkulose." Vienna. 1883. W. Braumüller.

³ March. 1883.

⁴ *Americ. Jour. Med. Sci.* Jan. 1885. *G. M. Sternberg*. Injection of finely powdered inorganic material into the abdominal cavity of rabbits, etc.

⁵ *Lancet*. Dec. 1883. P. 991.

⁶ *Lancet*. 1883. I. 441.

⁷ *Archiv für experiment. Patholog.* Vol. 17. P. 1.

⁸ Tuberculose Zoogloëique (Forme ou espèce de tuberculose sans bacilles). *Arch. d. physiol.* 1883. P. 370.

⁹ Der Bacillus der Pseudo-tuberculose des Kaninchens. *Fortschritte der Med.* Vol. III. P. 719.

easily accessible specimen of tuberculous pathology), and the relation of their number to the malignity of the process and to prognosis, were the first questions which received attention.

After Ehrlich¹—Lichtheim,² Ziehl,³ Balmer and Fraentzel,⁴ (over 500 cases),⁵ Crämer,⁶ Menche,⁷ in Germany; Heron,⁸ Dreschfeld,⁹ Williams,¹⁰ and others in England testified to the presence of bacilli in the sputum in those forms of tuberculous disease of the lungs, in which destructive processes were going on, communicating with the bronchi, and it was repeatedly pointed out "how examinations, to be trustworthy, should be repeated on successive days, since mistakes in prognosis might otherwise occur.

The presence of the bacilli in so-called cheesy pneumonia corroborated the theories as to its tuberculous character, while on the other hand their absence in chronic pneumonia proved this form of consumption not related to tuberculosis.

Hiller¹² first found bacilli in the early hæmoptysis of tuberculosis, proving that hæmorrhage was the effect and not the cause of the disease.

Rosenstein¹³ and Babes¹⁴ found the bacilli in the urine in cases of specific disease of the genito-urinary tract; Crämer,¹⁵ Lichtheim¹⁶ and

Vide notes on tubercle-bacilli. *Fortschritte der Med.* Vol. I. April 15. 1883. By C. Friedländer.

¹ *Diagnostische Verwerthung der Tub. Bac.* *Fortschritte der Med.* I. P. 4.

² *Zur Lehre von den Tub. Bac. etc.* *Deutsche Med. Wochschrft.* 1883. No. 5.

³ *Ueber das Verhalten der Tub. Bac. im Auswurf etc.* *Berl. Klin. Wochschrft.* 1882. No. 45.

⁴ O. Fräntzel. *Wie weit können wir den nachweis von Tub. Bac. etc. verwerthen?* *Deutsch. militärärztl. Zeitschr.* August. 1883.

⁵ *Die diagnost. Bedeutung der Tub. Bac.* *Sitzungsberichte d. phys.-med. Societ. in Erlangen.* Dec. 1882.

⁶ *Ueber die Tub. Bac. etc.* Vortrag, geh. i. d. med. Sek. d. Niederrhein. Ver. f. Natur. u. Heilkunde.

⁷ *Lancet.* Feb. 1883. P. 188.

⁸ *Brit. Med. Journal.* 17. Feb. 1883.

⁹ *Lancet.* 1883. I. P. 312.

¹⁰ *Fraentzel, I. c. Leyden, klinisches über Tub. Bac.* *Zeitschr. für klin. med.* 1884. VIII. 5 Heft.

¹² *Ueber initiale Hæmoptoe, etc.* *Deutsch. Med. Wochschrft.* 1882. No. 47.

¹³ *Vorkommen der Tub. Bac. im Harn.* *Centralbl. f. d. med. Wiss.* 1883. No. 5.

¹⁴ *Vide. Fortschr. d. med.* Vol. I. April 15. 1883.

¹⁵ I. c.

¹⁶ *Fortschritte der med.* Vol. I. P. 4.

De Giacomini¹ were able to trace them in fecal matter under similar conditions; and Weichselbaum,² Meisels³ and Lustig¹ found them in the blood in cases of acute miliary tuberculosis, both during life and after death.

Soon after the search for these parasites in the sputum had proved so successful, interest began to attach to their presence in surgical affections, a subject of more special interest to us here.

Schuchardt and Krause⁵ examined forty cases of tuberculosis of bones, joints, tendon-sheaths and the skin in Volkman's clinic, and found them always present, though the search for them was often tedious. They found them present in abscess membranes, tuberculous granulations, tuberculous lymphatic glands, and in tuberculous organs, such as the tongue, the uterus, the Fallopian tubes and testicles.

Schleghtendal⁶ now examined 520 specimens of pus from tuberculous suppurations, and was able to testify to the presence of bacilli in about 75 per cent. of the cases.

Mögling⁷ found bacilli in all (53) the surgical cases he examined in the Tübingen clinic and Mueller⁸ also corroborated the statement made by Krause and Schuchardt. In France, too, Brouilly⁹ published similar results.

Koenig in his work on tuberculosis of bones and joints¹⁰ refers to the presence of the bacilli in these diseases, although he could not always find them.

¹ Die diagnostische Bedeutung des Nachweises der Tub. Bac. im Stuhl. Fortschritte der Med. Vol. I. P. 145.

² Ueber Tub. Bac. im Blut, etc. Wien. Med. Wochschr. 1884. Nos. 12, 13.

³ Weitere Mittheilungen, etc. Wien. Med. Wochschr. 1884. Nos. 39, 40.

⁴ Ueber Tub. Bac. im Blut, etc. Wien. Med. Wochschr. 1884. No. 48.

⁵ Ueber das Vorkommen der Tub. Bac. bei fungösen und scrofulösen entzündungen. Fortschritte der Med. Vol. I. P. 277.

⁶ Ueber das Vorkommen der Tub. Bac. im eiter. Fortschr. der Med. Vol. I, P. 537.

⁷ Die chirurgischen Tuberkulosen. mittheilungen a. d. chir. Klinik zu Tübingen, Tübingen, 1884. II. Laupp.

⁸ Ueber den Befund von Tub. Bac. bei fungösen Knochen u. Gelenkaffectionen. Centrbl. f. chir. 1884, No. 3.

⁹ Note sur la présence des bacilles dans les lésions chirurg. tuberc. Rev. d. chir. 111. No. 11, Nov. 1883.

¹⁰ Berlin, 1884. Hirschwald.

The tuberculous nature of lupus long surmised from histological analogy (Friedlander) was clinically further elucidated by the finding of tubercle-bacilli in the affected skin by Demme¹ and Dontreleput (25 cases²) Cornil et Leloir³ and Pagenstecher and Pfeiffer⁴ also wrote on this subject. Orthmann⁵ found bacilli in the lymphatic glands communicating with a tuberculous mammary gland, and milk of cows similarly affected is well known to contain bacilli.⁶ Eschle,⁷ Voltoni and Nathan have traced tuberculous otitis by means of bacilli contained in the pus discharged.

Quite recently the discovery of tubercle-bacilli in hygromata and tendo-synovites with oryzoid corpuscles or melon-seed bodies by Nicaise, Poulet, Vaillard,⁸ and also in the warty skin affections of pathological anatomists by Karg⁹ and Riehl¹⁰ has led to the discovery of the probable tuberculous nature of these affections, although the infection may be a mixed one.

Giesler¹¹ on the other hand was not able to find bacilli in the infiltrations and abscesses of the integument in scrofulous children, and believes them not to be tuberculous in nature.

Soon after Koch's discovery had thrown some light upon the etiology of tuberculous disease, various efforts were made to find a therapeutic agent capable of directly attacking the organized virus; and such a

¹Wide note in Fortschritte der Med. Vol. 1., April 15. Beil.

²Tuberkel Bac. in Lupus. Monatshefte für pract. Dermatol. 1883, No. 6. Aetiologie des Lupus vulgaris. Vierteljahrsschrift für Dermatol. u. Syphilis, 1884.

³Recherches expérimentales et histolog. etc. Arch. de physiol. norm et path. 1884. No. 3.

⁴Lupus oder Tuberculose? Berl. Klin. Wochschrft. 1883, No. 19.

⁵Ueber Tuberculose der weibl. Brustdrüse, etc. Virchow's Archiv. Vol. 100. III.

⁶Bang. Ueber tuberkulöse Milch. Deutsch. Zeitschrift f. Thiermed. u. vergl. Path. XI. P. 45.

⁷Bollinger. Ueber Tub. Bac. im Enter, etc. Münchener ärztl. Intell. Blatt. No. 16. 1883.

⁸Habermann. Mittheilungen über Tuberculose des Schilddrüsens. Prag. Med. Wochschrft. 1885, No. 6.

⁹Nature tuberculeuse des Hygromas, etc. Revue de chir. V. No. 8. 1885. P. 609.

¹⁰Tuberkel-Bacillen in einem sogenannten Leichentuberkel. Centralbl. f. chir. 1885, No. 32.

¹¹Ibid. No. 36. Riehl u. Pelltauf. Vierteljahrsschrift für Dermatol. u. Syphilis.

one Buchner¹ believed to have found in arsenic. His statements deduced from six cases were partly corroborated by Kempner,² who published twelve cases. But Stinzing's work³ founded on twenty-two cases soon dispelled the hopes awakened by these publications and proved arsenic to be rather more harmful than beneficial.

A similar recommendation of arsenic for surgical tuberculous affections was published by Landerer.⁴

The question as to the hereditary transmission of tuberculous disease was also much agitated in consequence of the bacillary doctrine, and is still at the present time unsettled.

Favorers of the theory of infection found no difficulty in illustrating the possibility of infection which obtains in the homes of tuberculous individuals, reasoning by analogy from the numerous experiments by which animals were rendered tuberculous by inhaling dust containing tubercle-bacilli,⁵ and sanitary measures to destroy the highly infectious nature of the dried sputum of phthisical patients were insisted upon by hygienists—a one in twenty carbolic acid solution being found the most efficient disinfectant, an equal amount being added to the sputum and left in contact with it for a period of twenty-four hours.⁶ It was repeatedly pointed out that in Italy phthisis had always been looked upon as a contagious disease, and cases of acquired pulmonary phthisis by healthy individuals were published in the periodicals.⁷

On the other hand unimpeachable cases of transmittal of the disease in utero were published by authorities on this question,⁸ so that there

¹ Die subcutanen Kalten Abscesse, etc. *Jahrb. für Kinderheilkunde*. Vol. 23. 11. 2. P. 37.

² Die aetiologische Therapie etc. der Lungen-tuberculose. München und Leipzig. 1883.

³ Ueber die Behandlung der Tub. mit Arsen. *Berlin. Klin. Wochenschr.* 1883, No. 31.

⁴ Zu Buchner's aetiolog. Therap. etc. *ärztl. Intell. blatt*. 1883. No. 30. *Centbl. f. Klin. Med.* No. 32. 1883.

⁵ *Centralblatt f. Chirurg.* 1883.

⁶ Koch. *Ätiologie der Tuberculose*, l. c.

⁷ *Veraguth. Experimentelle Untersuchungen über Inhalations tuberculose. Archiv. für experim. Pathol. u. Thierm.* Vol. 17.

⁸ Schill and Fischer. *Mittheil. a. d. Kaiserl. Gesundheitsamte*. P. 131. Vol. II. Berlin. 1884. Hirschwald.

⁹ Herterich. Ein Fall von Fütterungs tuberculose, etc. *Münch. ärztl. Intell. blatt*. 1883. No. 26.

appears to be little doubt but that both methods of acquiring tuberculosis are possible.

New and altered methods for staining the tubercle-bacilli have been repeatedly suggested¹ since the method of Ehrlich-Weigert was first adopted by Koch. But most of the proposed methods proved to be either unreliable, or at least unimportant, such as the suggestion of transferring the cover-glasses with the adherent bacilli from the solution of fuchsin in aniline-water directly into a mixture composed of absolute alcohol (50 parts), distilled water (30 parts), pure nitric acid (20 parts) and methylene blue (10 parts), and leaving it there for a few seconds before washing it out, instead of first using dilute acid for discoloration and afterwards staining with the blue color.

A more important suggestion, however, has been lately made by Neelsen, of Rostock,² which is especially time-saving, since it does away with the tedious preparing of the aniline-water in each successive examination. The directions are as follows: The cover-glasses with the fluid specimen dried onto them and rendered adherent by direct application of moderate heat, are placed in a solution composed of one part of fuchsin (rosanilin), 100 parts of a five-per-cent. aqueous solution of carbolic acid, and ten parts of alcohol. This mixture is then to be heated until fumes arise; in this mixture, which may be preserved for any length of time, the staining is rapidly accomplished. The glasses are then to be washed in diluted sulphuric acid (25 per cent.), colored with methylene blue, washed again, dipped into cedar-oil and mounted in Canada balsam, prepared without chloroform. The same process may be used for sections, five to ten minutes sufficing to stain them at 65° F., and alcohol being used for washing off the superfluous coloring. The use of palladium chloride for the purpose of fixing the colors to prevent the subsequent fading of the stained bacilli has also proved of much value.

Especial attention is necessary when staining fatty secretions to avoid

¹ *Johnc.* Ein Zweifelloser Fall von congenitaler Tuberculose. Fortschritte der Med. Vol. 3. P. 198.

² *Zichl.* Deutsch. med. Wochschrft. 1882. No. 33. 1883. No. 17, etc.

³ Published by *Johnc.* Fortschritte der Med. Vol. III. P. 200. Foot-note.

⁴ *Bienstock.* Zur Frage der sog. Syphilis-bacillen und der Tub. Bac. Färbung. Fortschritte der Med. Vol. IV. P. 193.

confounding certain other forms of bacilli with the specific tubercle-bacilli. Those of leprosy, for instance, show a similar reaction.

It has also been shown¹ that micro-organisms when triturated with fatty matter are not acted upon by acids and consequently not discolored by their application, probably in consequence of the mechanical qualities of the fatty substances enveloping them.² Such properties of the micro-organisms, however, disappear when they are cultivated in pure cultures, unless the culture soils are especially prepared with butter.³ In any case, however, specific tubercle-bacilli can be distinguished, even from micro-organisms occurring in fatty media, as for instance from those of smegma. W. W. VAN ARSDALE.

¹ *Matterstock*, Deutsche Med. Wochschrft. 1885. P. 837. Ueber Bacillen bei Syphilis. Mittheil. a. d. med. Klinik d. Univ. Würzburg. Vol. II. Wiesbaden. Bergmann. Vide also *Gottstein's* review of *Azwarcz* and *Tavel* and *Klemperer* in Fortschritte der Med. Vol. IV. P. 141.

² *C. Friedländer*. Ueber die färberische Reaction der Tuberkelbacillen. Fortschr. d. Med. Vol. IV. P. 196.

³ *Bienstock*. Zur Frage der sog. Syphilisbacillen und der Tub. Bac. Färbung. Fortschritte der Med. Vol. IV. P. 183.